KOOTENAI RIVER INVESTIGATION: LOWER WEST SIDE TRIBUTARY USE ASSESSMENT OF KOOTENAI RIVER BURBOT *Lota lota*

FINAL REPORT
November 1, 2003—April 31, 2004

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In Cooperation with the
Kootenai Tribe of Idaho

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ABSTRACT

Historically the west side tributaries of the Kootenai River, Idaho are thought to have been important spawning and rearing habitat for Kootenai River burbot *Lota lota*. However, since the collapse of the burbot population in Idaho, there has been no inventory of their present use of these tributaries for spawning. The objectives of this investigation were to identify Kootenai River tributaries utilized by burbot during the winter, enumerate spawning burbot within those tributaries, and radio track burbot movement within the tributaries. Sampling for burbot occurred in Deep, Long Canyon, Boundary, and Trout creeks and was carried out from late October 2003 through March 2004. Sampling gears included weir traps (Deep, Long Canyon, and Trout creeks) and baited hoop nets (Deep, Long Canyon, Boundary, and Trout creeks). In addition, water temperature was recorded with Onset© Tidbit thermographs deployed near each weir trap. Thermographs were also deployed at upper Deep, upper Long Canyon, upper South Fork Trout, upper and lower North Fork Trout, upper and lower Ball, and upper and lower Parker creeks. Kootenai River temperatures were obtained from the U.S. Army Corps of Engineers. Ninety-seven fish from eight different species were captured in the weir traps, and 36 fish of eight species were caught by hoop net. No burbot were captured with the weir traps, while only one burbot was captured with a hoop net on February 9, 2004 in Boundary Creek. The burbot was 515 mm in length and weighed 930 g. Visual surveys were also made during the day and night on tributaries, but no burbot were seen.

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INTRODUCTION

Burbot *Lota lota* are a freshwater cod and are found in the northern hemisphere throughout a circumpolar range (McPhail and Paragamian 2000). Burbot are winter spawners and known to spawn in a variety of habitats including lakes (Clemens 1951; McCrimmon and Devitt 1954; Ghan and Sprules 1991), rivers (Cahn 1936; Chen 1969; Breeser et al. 1988), and streams (Arndt and Hutchinson 2000). Burbot have semibuoyant eggs that when deposited in tributaries may drift downstream to be carried to larger nursery lakes or rivers or may lodge in crevices to incubate and rear in the stream (McPhail and Paragamian 2000).

According to anecdotal information, tributaries to the Kootenai River downstream of Bonners Ferry, Idaho are thought to have been important to spawning burbot (Figure 1). Anglers interviewed in the early 1990s reported large numbers of burbot migrating into Idaho tributaries each winter prior to the collapse of the fishery during the 1970s. The only significant record was recorded in the winter of 1957-1958 when a state fisheries biologist captured 199 burbot with net gear near the mouth of Boundary Creek (Partridge 1983). A general field survey conducted in 1994 involved walking the banks of streams to visually detect evidence of burbot, but provided no evidence of spawning burbot (Paragamian 1995). Partridge (1983) reported burbot were observed spawning under the ice in tributaries prior to their decline. Partridge (1983) also reported catching a prejuvenile burbot (74 mm) in Smith Creek and an adult burbot in Deep Creek. Fredericks and Fleck (1995) captured a prejuvenile burbot in a minnow trap below Trout Creek. Paragamian and Whitman (2000) captured two burbot in Boundary Creek in hoop nets during a winter investigation. One of the burbot captured by Paragamian and Whitman (2000) was caught several months earlier at Nicks Island in British Columbia (rkm 144.5).

Sampling for burbot in the Idaho tributaries has been nonexistent since the early 1980s (Partridge 1983). There are several reasons for this lack of effort. Libby Dam operations often cause extreme raising and lowering of the Kootenai River water levels, thus creating a logistic problem for deployment and maintenance of gear when the focal areas for spawning burbot are within this floodplain.

To date, only two burbot have been captured in hoop netting efforts within Idaho tributaries, both coming from Boundary Creek (Paragamian and Whitman 2000). In the winter of 2002-2003, a dead burbot was found along the banks of Deep Creek, and local anglers reported seeing burbot in the mouth of this same creek in February 2003 when Kootenai River flows were low. This information suggests a remnant burbot stock may still be using some tributaries in Idaho. Thus, an investigation to determine the extent of the use of west side tributaries by burbot spawners would be important to the management and recovery of this fish.

The consequences of post-dam changes in winter flows and temperature of the Kootenai River and tributaries downstream of Libby Dam may be important to the decline in burbot. Burbot are winter spawners and often spawn under the ice in January through March (Becker 1983; McPhail and Paragamian 2000). Prior to the dam, the Kootenai River frequently froze completely over during these months. Burbot spawn at about 1.5°C, or near freezing temperatures (MacKay 1963; Becker 1983). Since 1974, the winter river temperatures are now 3-4°C as opposed to the pre-dam years when temperatures were near 1°C and less. Temperatures of several Kootenai River tributaries were investigated from 1996 through 2003. Two thermographs were deployed in several streams, with one at the confluence with the river and the second 100 m upstream from the confluence. It was found that warmer river temperature mitigates the cooler tributary temperature through mixing action, thus making this

mixing zone slightly warmer than the tributary but cooler than the mainstem Kootenai River. It is not known how this mixing action may affect burbot spawners. It seems unlikely that temperature alone could have led to the demise of burbot, because some populations are known to spawn at slightly warmer temperatures (McPhail and Paragamian 2000), although burbot appear to be attracted to colder water (Paragamian 1995). Furthermore, compared to even pre-Libby Dam the tributaries are now channelized, disconnected from the floodplain, and connect to the river at right angles.

OBJECTIVES

Burbot in the Kootenai River are now thought to number fewer than 500 fish. Lack of critical spawning habitat and lower river productivity coupled with high mainstem Kootenai River flows during the winter months are thought to be important factors regarding the presence or absence of spawning burbot in the tributaries and to the overall decline in burbot numbers. This investigation was initiated to understand the status of burbot in the tributaries of the lower Kootenai River during the prespawn and spawning season and was designed to address burbot abundance, distribution by tributary, reproductive success, and movement. Information gathered from the west side tributaries is important to habitat enhancement for burbot and population recovery. The overall goal of this project was to identify tributaries that burbot use in order to help prioritize restoration efforts on the lower west side tributaries.

The main objectives of this project were to:

1. Identify Kootenai River tributaries utilized by burbot during the winter,
2. Enumerate spawning burbot within those tributaries,
3. Track burbot movement in the tributaries using radio telemetry, and
4. Determine winter tributary water temperatures and how they may relate to burbot spawn timing.

Tasks not reported in this document were:

1. Collect genetic samples from burbot for species identification, and
2. Analyze dead burbot for pathogens, pesticides, and metals contamination.

STUDY SITES

The Kootenai River is in the upper Columbia River Basin. The river originates in Kootenay National Park (U.S. and Canadian spellings for Kootenai differ), BC, flows south into Montana, turns northwest at the site of Libby Dam, and is of high gradient (Figure 1). As the river flows through the northeast corner of the Idaho Panhandle, it reaches a braided meander reach, transitions into a meandering reach, shifts to the north, and enters Kootenay Lake, BC. To the west of the Kootenai River are the Selkirk Mountains. Tributaries to the Kootenai River from the Selkirk's are of high gradient until they reach the valley floor, where they are dyked from the flood plain and are of very low gradient. The Kootenay River joins the Columbia River

at Castlegar, BC. Our primary study tributaries for this investigation were from rkm 170.0, Boundary Creek, to rkm 241.0, Deep Creek, all downstream from the city of Bonners Ferry, Idaho (Figure 1).

The eight lower west side Kootenai River tributaries investigated included: Boundary, Long Canyon, Parker, Mission, Ball, Trout, Myrtle, and Deep creeks (Figure 1). Upstream and downstream fish weir traps were installed in Long Canyon, South Fork Trout, and Deep creeks. The placement of the three weirs was based primarily upon the likelihood of capturing burbot but also served to gather winter fish population data.

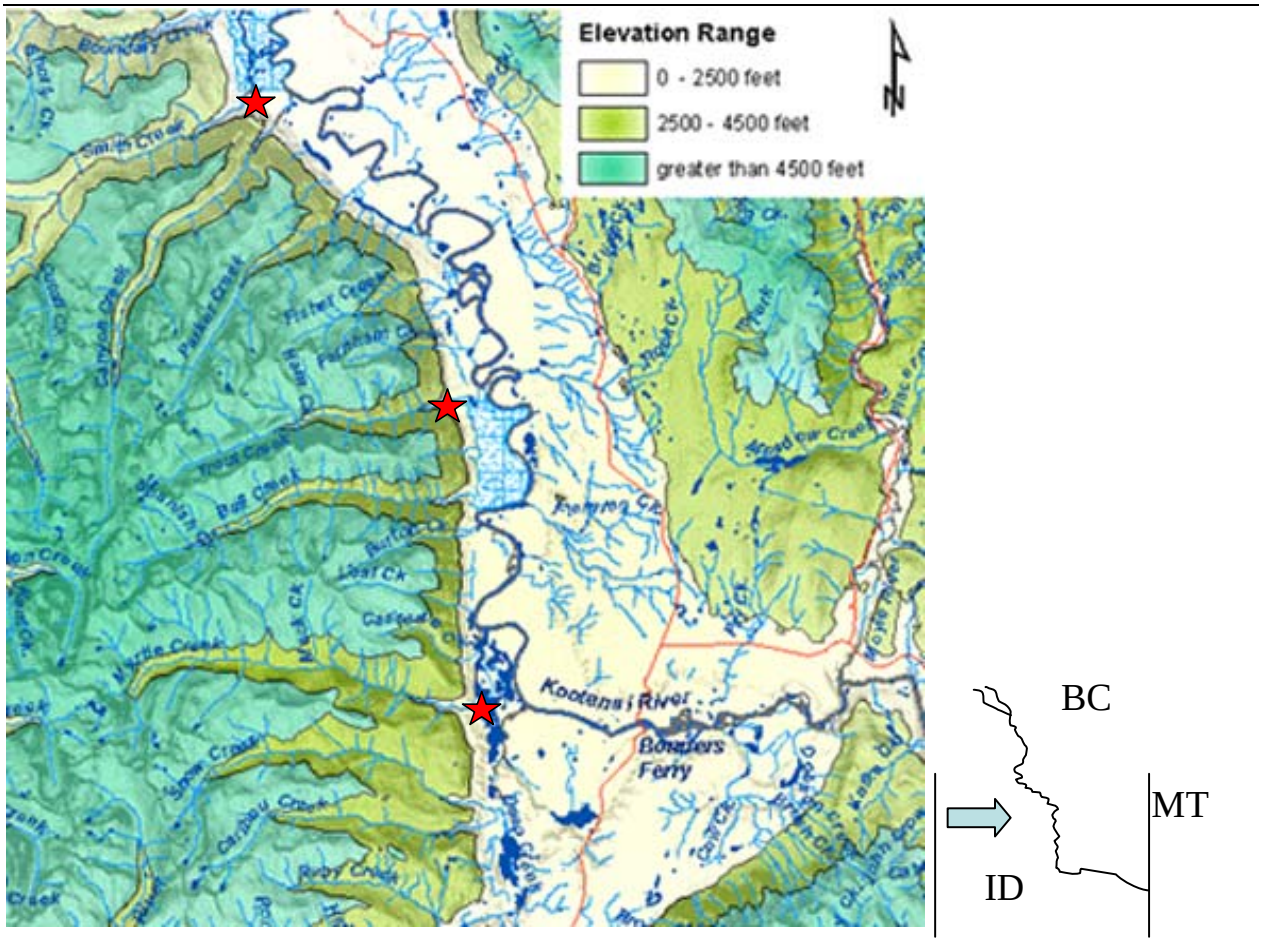


Figure 1. Location of the weirs and Kootenai River tributaries investigated in this study. Map courtesy of the Wetland Riparian Conservation Strategy (KTOI 2004). Inset shows Kootenai River, Idaho (ID), British Columbia (BC), and Montana (MT) and the arrow indicates the general location of west side tributaries.

METHODS

An Onset© Tidbit thermograph was deployed near each weir trap (Deep, Trout, and Long Canyon creeks) to monitor temperature throughout the winter and spring (n = 3). Thermographs were also placed at the upper end of the tributaries (out of Kootenai River influence) to determine temperature gradients between the tributaries and the mainstem Kootenai River. Thermographs were deployed at upper Deep, upper Long Canyon, upper South Fork Trout, upper and lower North Fork Trout, upper and lower Ball, and upper and lower Parker creeks (n = 9). Kootenai River temperatures were obtained from the U.S. Army Corps of Engineers gauging station (#12301933) below Libby Dam. Thermographs (n_{total} = 12) were installed by the end of November 2003 and retrieved by the end of March 2004. We configured each thermograph to record temperatures every two hours (12 readings per day). We estimated the mean daily temperature for each stream as the average of the 12 temperatures recorded at the site for the day.

Sampling Adult Burbot

Upstream/Downstream Trapping

Three streams were selected for weir trapping: Deep, South Fork of Trout, and Long Canyon creeks. Deep Creek was chosen because a dead burbot was retrieved from its banks the previous winter, and it was suspected that burbot were using this stream for spawning. The South Fork of Trout and Long Canyon creeks were chosen because they appeared to have good spawning habitat for burbot, and restoration efforts are in progress on both tributaries. Winter catch data could also be used for these important projects.

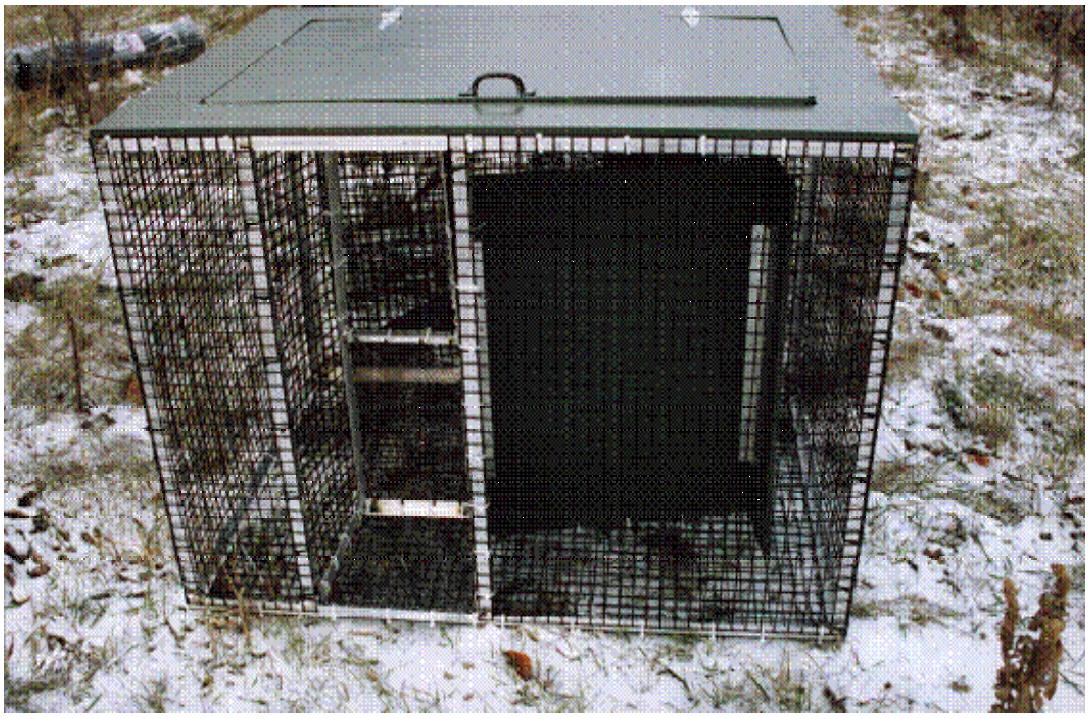
All three tributary weirs were placed as close to the confluence with the Kootenai River as possible, taking into account the potential for large fluctuations in water level from the mainstem river. The possibility of moving the weirs was very high.

Upstream/downstream weir traps were installed in three target tributaries (Deep, Trout, and Long Canyon creeks) (n = 3). A conduit weir effectively channeled migrating fish into the weir trap (Figure 2a and 2b). The weir traps consisted of an aluminum frame (1.52 m x 1.22 m x 1.22 m) covered in 3.8 cm stainless steel plastic-coated mesh. The top of the trap was marine-grade plywood coated in epoxy resin to prevent excessive wear. The fish entered the trap via a 30 cm diameter cone constructed of Vexar® mesh. The cone was necked down to 18 cm to prevent escapement. The cone was approximately 15 cm above the trap bottom.

Because of its size and location, the Deep Creek weir traps were not installed until December 22, 2003 after the high water in the Kootenai River abated and had to be removed March 11, 2004 due to rising water levels. Weir traps located in South Fork Trout Creek were installed November 21, 2003 and run through March 22, 2004. The weir traps in Long Canyon Creek were installed November 25, 2003 and were run through March 22, 2004.

All captured fish were weighed, measured, marked with a fin clip, and released either upstream or downstream of the weir, depending upon the fish's in-stream movement. If needed, fish were anesthetized with MS-222. All burbot were marked with a PIT tag inserted into the fish's left cheek to identify recaptures. A small tissue sample was taken from the caudal fin to be preserved for a genetic sample. Genetic samples were placed in sample vials filled with Lysis buffer solution. The weir traps were inspected and cleaned daily.

a.



b.

Figure 2. Upstream and downstream (2a), and downstream (2b) weir trap configuration.

Hoop Net Trapping

Hoop nets were placed in five tributaries to the Kootenai River in an attempt to sample burbot moving upstream to spawn during the winter months. These tributaries include Deep, Ball, South Fork Trout, Mission, and Boundary creeks. One hoop net was set per creek with the exception of Boundary Creek, which had two. The sampling period began with the first net placed in South Fork Trout Creek on November 20, 2003 and ended on March 21, 2004 with the removal of two nets from Boundary Creek. Hoop nets were comprised of 25 cm bar mesh and were 3.06 m long with 0.61 m entrance diameter (Bernard et al. 1991) (Figure 3). Hoop nets were baited with smelt *Osmerus mordax* and were checked every 48 to 72 hours. All fish species captured were weighed, measured in total length (TL), and marked with an upper caudal fin clip. After a burbot was captured in Boundary Creek, nets were positioned downstream and upstream of the original net in an attempt to capture other burbot.

Factors influencing the placement of hoop nets included relative position to the confluence, maximum depth, water velocity, ice cover, and sediment deposition. Efforts were made to keep all hoop nets (except in Boundary Creek after the first capture) as close to the mouths as possible and in the deepest water when at all possible. This posed a task due to ice cover and the high fluctuations in flows in the mainstem Kootenai River due to Libby Dam and seasonal runoff.

Figure 3. A technician retrieving a baited hoop net from under the ice at Boundary Creek, Idaho.

Stream Surveys

In late December, six major westside tributaries were visually surveyed for the presence of burbot (Myrtle, Ball, Deep, Trout, Boundary, and Long Canyon creeks. The tributaries were surveyed from their confluence with the mainstem Kootenai River to an appropriate stopping point (possibly cascades, waterfalls, or habitat generally not used by burbot). Surveys were conducted by boat in Deep and Boundary creeks; on foot in Trout, Long Canyon, and Myrtle creeks and by both methods in Ball Creek. Surveys were conducted during both the night and day with 1 million candlepower flashlights.

Radio Telemetry

Radio Telemetry

Radio transmitters were to be used to track the movement of burbot during the winter of 2003-2004 and possibly to identify the spawning areas of burbot and the length and frequency of their movement. We expected to attach 50 day, 4.7 g radio transmitters (ATS; model #F1560; duty cycle 8 h on/16 h off; 40 ppm) to burbot. Radio telemetry was to be conducted via boat and/or on foot. Aerial location of radio transmitters was also anticipated when a burbot moved long distance. However, no tags were deployed.

External Radio Transmitter Attachment

The radio transmitters were to be wrapped with 9 kg FireLine© fishing wire and sealed with epoxy to provide points of attachment. After anesthetizing the burbot with MS-222, the Fireline© was fed through the skin in the anterior portion of the second dorsal fin with a #12 gage 1.5 in stainless steel needle. Two plastic 2.5 cm diameter Peterson discs were to be placed on the opposite side of the tag to prevent excessive chafing, and the Fireline© was crimped with steel ends. This procedure should have taken between 10 and 15 minutes to complete. After the transmitter was attached, the burbot would be allowed to recover in fresh river water. Before deployment, the transmitter was to be checked to make sure it was functioning properly and the specific frequency noted in the datasheets. We anticipated tracking burbot at least three times/week. All tracking information and effort was to be recorded and burbot locations were to be determined with a GPS unit.

RESULTS

Kootenai River Temperatures

Between January 14 and March 25, 2004, the mean ambient Kootenai River water temperature was 3.0°C and ranged between 2.5 and 3.9°C. Mean Kootenai River flow was 117.3 $m^3 \cdot s^{-1}$(Figure 4).

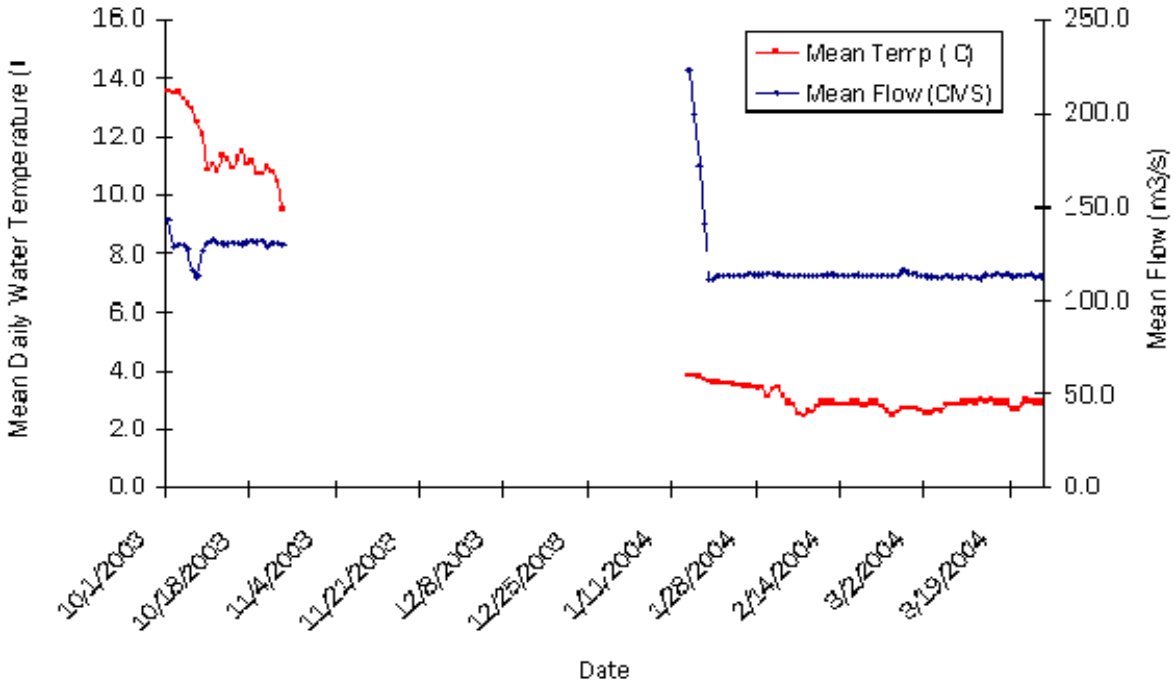


Figure 4. Temperature (°C) and discharge (m^3/s) in the Kootenai River, Idaho from October 1, 2003 to March 24, 2004. Data obtained from the U.S. Army Corps of Engineers (Station #12301933). Data was unavailable from about October 27, 2003 through January 12, 2004.

Tributary Temperatures

Temperature at the trap sites varied throughout this investigation (Table 1 and Figure 5). The lower Deep Creek thermograph, located downstream of the trap site, did not function properly; therefore, no temperatures were recorded. Mean upper Deep Creek water temperature was 1.3°C from November 15, 2003 through March 19, 2004 (Figure 5). Trout Creek weir site was the warmest of the three sites, including Long Canyon site, up to 3.3°C in mid January (Figure 5). Between November 20 and January 21, mean ambient water temperature was 0.2°C. South Fork Trout Creek mean water temperatures were the warmest of the tributaries sampled, with a mean temperature of 2.6°C from November 19, 2003 to March 14, 2004. Mean water temperature in the upper South Fork Trout Creek was 1.1°C (Table 1 and Figure 6). Long Canyon water temperatures were the coldest of the three trap sites with a mean of 1.0°C at the trap site and 1.1°C in the upper section (Figure 7).

Table 1. Summary of mean November 2003 through March 2004 temperatures °C.

Stream	Upper Site	Lower Site
Deep Creek	1.3	NA
South Fork Trout Creek	1.1	2.6
Long Canyon Creek	1.1	1.0
North Fork Trout Creek	1.3	NA
Ball Creek	0.9	2.9
Parker Creek	0.9	0.9

Other water temperatures were measured in the North Fork of Trout Creek, Ball Creek, and Parker Creek. Mean water temperature in the upper reach of North Fork Trout Creek was 1.3°C (Figure 8). Mean ambient water temperatures in upper and lower Ball Creek were 0.9 and 2.9°C, respectively, between November 17, 2003 and March 19, 2004 (Figure 9). Mean ambient water temperatures in upper and lower Parker Creek were both 0.9°C between November 19, 2003 and March 19, 2004 (Figure 10). In general, mean ambient water temperatures were coldest in Long Canyon Creek (1.0°C) and warmest in the South Fork of Trout Creek (2.6°C) and Ball Creek (2.9°C).

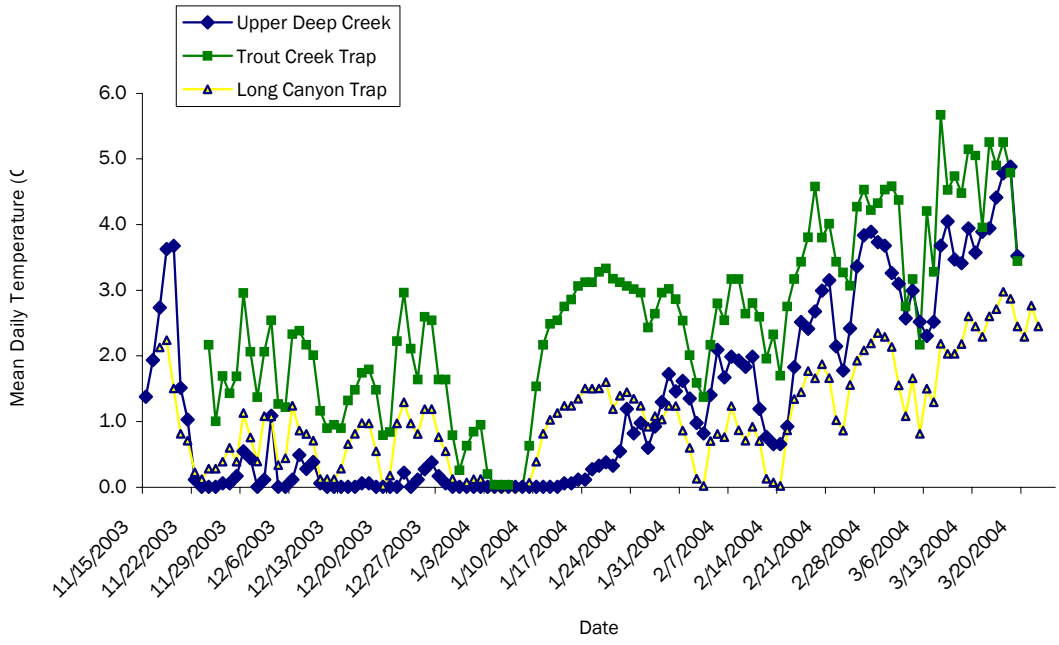


Figure 5. Mean daily water temperature (°C) from November 15, 2003 to March 25, 2004 at the weir traps in Upper Deep Creek, South Fork Trout and Long Canyon creeks. The mean daily temperature for each site and day was estimated by averaging the 12 temperature readings collected for the day at the site.

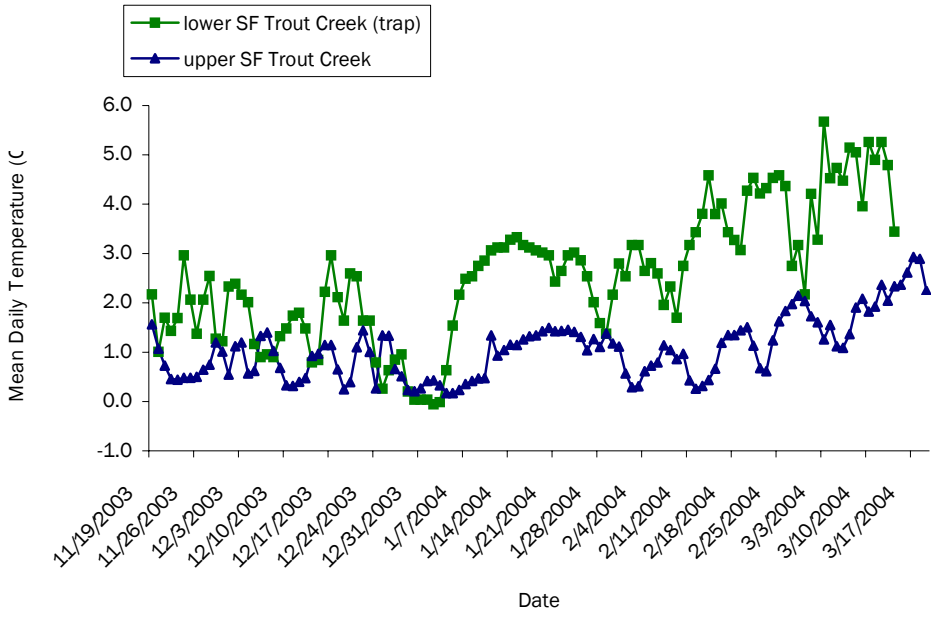


Figure 6. Mean daily water temperature (°C) from November 19, 2003 to March 14, 2004 in the upper and lower reaches of the South Fork of Trout Creek. The mean daily temperature for each site and day was estimated by averaging the 12 temperature readings collected for the day at the site.

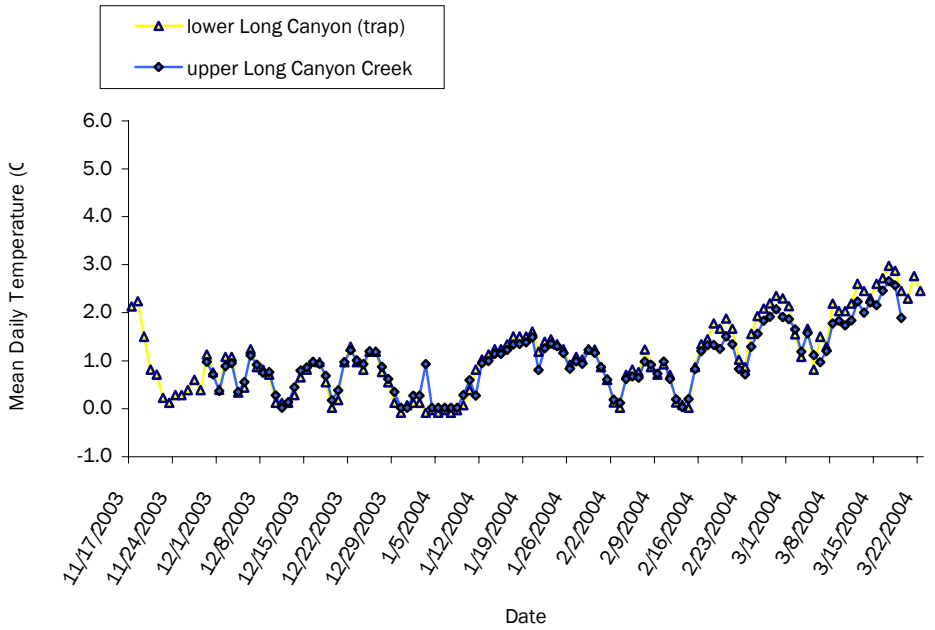


Figure 7. Mean daily water temperature (°C) from November 17, 2003 to March 22, 2004 in the upper and lower reaches of Long Canyon Creek. The mean daily temperature for each site and day was estimated by averaging the 12 temperature readings collected for the day at the site.

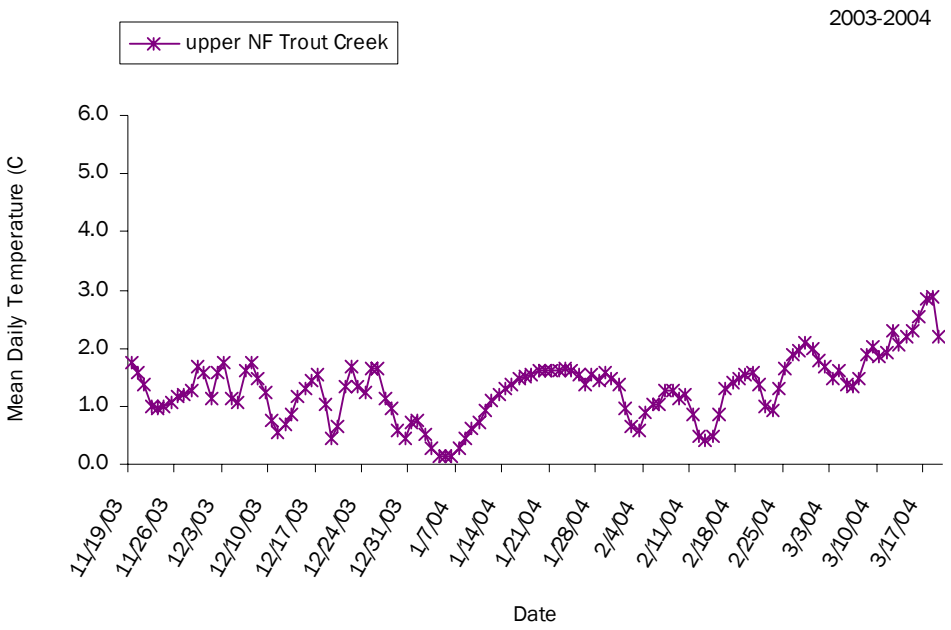


Figure 8. Mean daily water temperature (°C) from November 19, 2003 to March 19, 2004 in the upper reach of the North Fork of Trout Creek. The mean daily temperature for each site and day was estimated by averaging the 12 temperature readings collected for the day at the site.

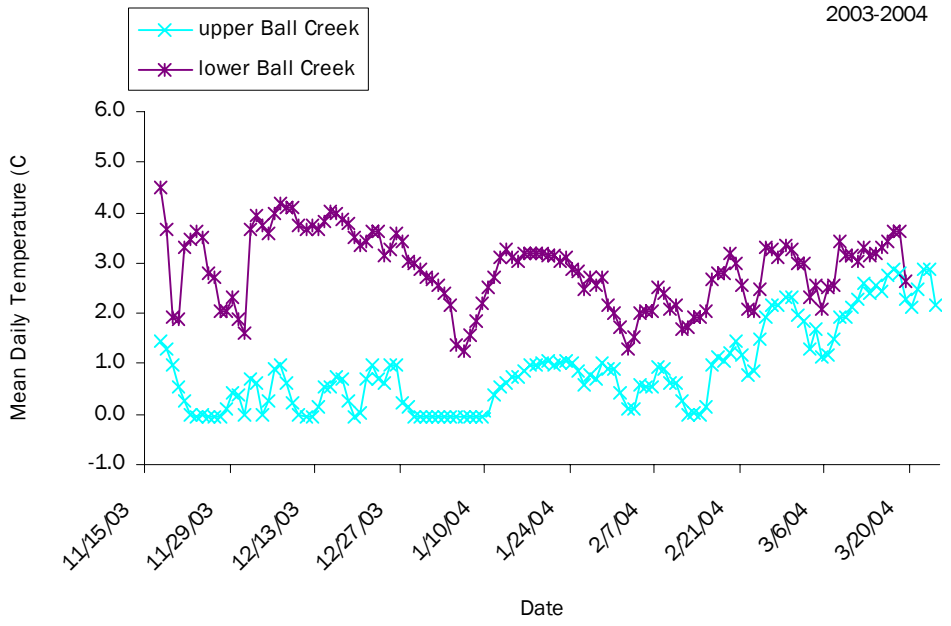


Figure 9. Mean daily water temperature (°C) from November 17, 2003 to March 19, 2004 in the upper and lower reaches of Ball Creek. The mean daily temperature for each site and day was estimated by averaging the 12 temperature readings collected for the day at the site.

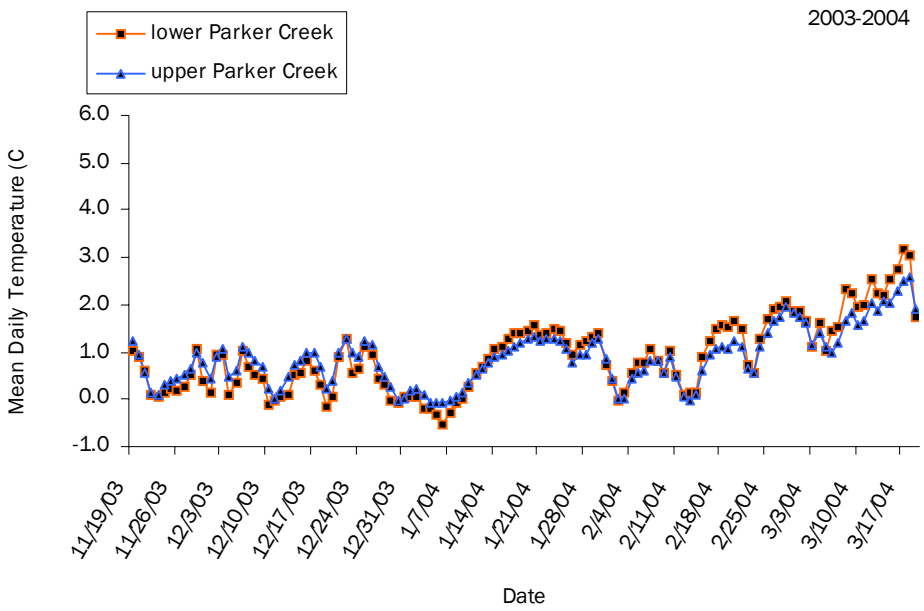


Figure 10. Mean daily water temperature (°C) from November 19, 2003 to March 19, 2004 in the upper and lower reaches of Parker Creek. The mean daily temperature for each site and day was estimated by averaging the 12 temperature readings collected for the day at the site.

Upstream/Downstream Trapping

Water levels of tributary streams near their mouths with the Kootenai River continuously dropped throughout November and December. As a result, weir sites had to be moved and placed according to water elevation.

Deep Creek

The upstream and downstream weir traps were installed in Deep Creek on December 22, 2003 and fish were captured immediately (Appendices 1 and 2). Substrate composition was primarily sand, which posed some erosion problems over the course of the study. Due to erosion and an increase in flow, the weir was moved downstream on February 13, 2004. Forty-four individual fish were caught. The most prevalent species of fish caught was mountain whitefish *Prosopium williamsoni* (Table 2), with longnose sucker *Catostomus catostomus* and rainbow trout *Oncorhynchus mykiss* also captured. No burbot were captured, but a decomposing female burbot carcass was found on the Deep Creek dike in early March, approximately 2 km downstream of the weir traps. No fish were captured in either weir trap from February 20 to March 11, 2004.

The length frequency distribution of mountain whitefish suggests there were two year-classes caught between late December 2003 and late February 2004 (Figure 11).

Table 2. Fish species and number captured in the downstream and upstream weir traps located in Deep Creek, Idaho.

Species	Captures	Recaptured
Downstream move		
Peamouth Chub	3	1
Rainbow Trout	1	0
Mountain Whitefish	36	3
Bull Trout		
Eastern Brook Trout		
Upstream move		
Longnose sucker	1	1
Rainbow Trout	1	1
Mountain Whitefish	7	0
Eastern Brook Trout	1	0
Total	**50**	**6**

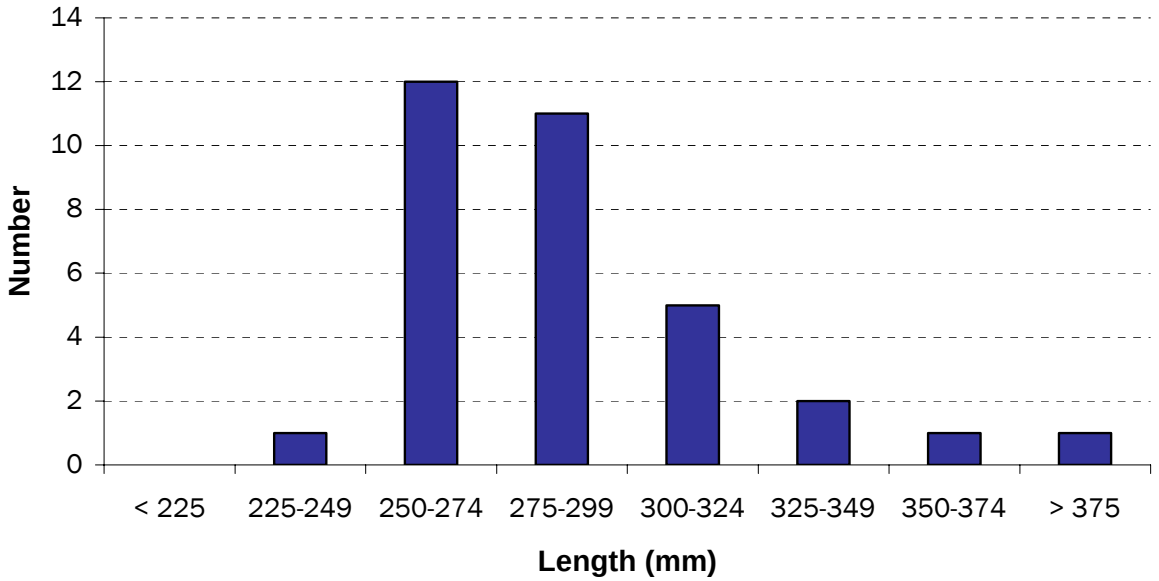


Figure 11. Length frequency histogram of downstream movement of mountain whitefish captured in Deep Creek from December 2003 to March 2004.

South Fork of Trout Creek

The weir traps were installed in the south fork of Trout Creek on November 21, 2003 and operated through March 22, 2004 (Appendix 3). Substrate composition was primarily gravel and sand. Due to the significant decrease in Kootenai River flows, water depth in Trout Creek dropped and the weir had to be moved to a more suitable location. The weir was moved approximately 20 m downstream on December 24, 2003. Four individual fish were caught of four species (Table 3). No burbot were captured. No fish were captured in either weir trap from January 9 to March 22, 2004.

Table 3. Fish species and number captured in the downstream and upstream weir traps located in South Fork Trout Creek, Idaho.

Species	Captures	Recaptures
Downstream move		
Longnose sucker	1	0
Mountain whitefish	2	1
Upstream move		
Rainbow trout	1	0
Mountain whitefish	1	0
Total	**5**	**1**

Long Canyon Creek

The weir traps were installed in Long Canyon Creek on November 25, 2003 (Appendix 4). The substrate composition was primarily gravel and cobble. Forty individual fish were caught, two of which were recaptured (Table 4). The most prevalent species of fish caught was the peamouth chub *Mylocheilus caurinus* (Table 4), with longnose sucker, northern pikeminnow *Ptychocheilus oregonensis*, eastern brook trout *Salvelinus fontinalis*, and rainbow trout also captured. One juvenile bull trout *S. confluentus* was captured while it was moving downstream. No burbot were captured. No fish were captured in either trap from January 26 to March 22, 2004.

There were possibly two year-classes of peamouth chub caught migrating upstream in Long Canyon Creek in December 2003 (Figure 12). All peamouth chub upstream movement occurred between December 4 and December 18, 2003.

Table 4. Fish species and number captured in the downstream and upstream weir traps located in Long Canyon Creek, Idaho.

Species	Captures	Recaptured
Downstream move		
Peamouth Chub	4	0
Rainbow Trout	2	0
Mountain Whitefish	1	1
Bull Trout	1	0
Eastern Brook Trout	1	0
Upstream move		
Peamouth Chub	24	1
Rainbow Trout	1	1
Mountain Whitefish	2	0
Northern Pikeminnow	4	0
Slimy Sculpin *Cottus cognatus*	0	1
Eastern Brook Trout	1	0
Total	**42**	**2**

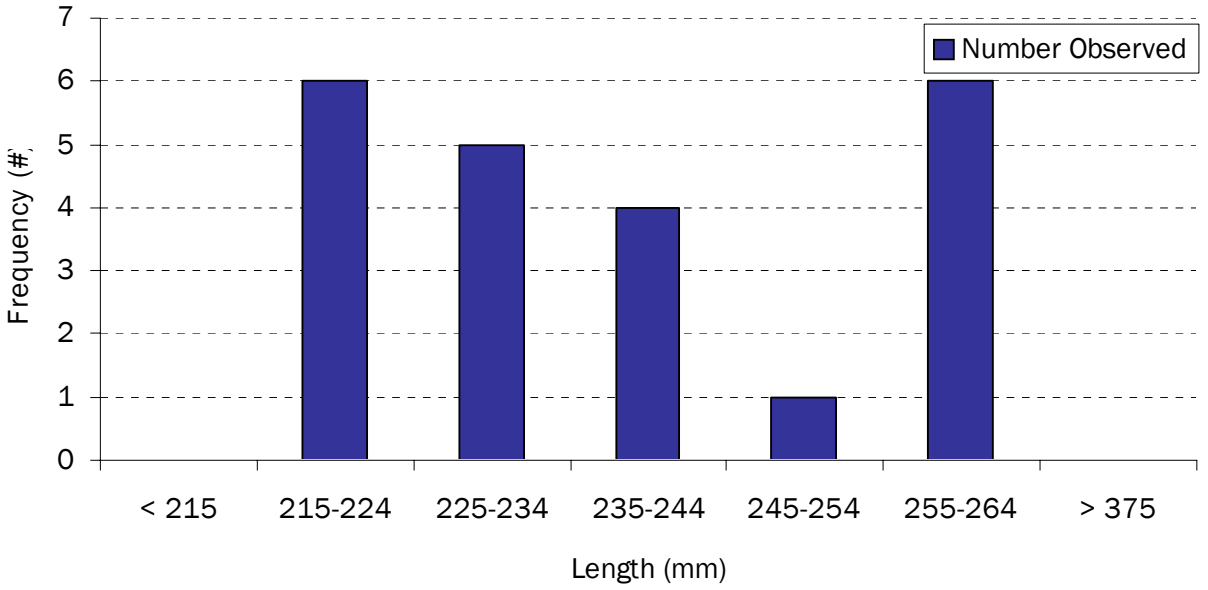


Figure 12. Length frequency histogram of downstream movement of peamouth chub captured in Long Canyon Creek from December 4 though 18, 2003.

Hoop Net Trapping

Hoop nets were deployed in five tributaries in an attempt to capture burbot in their upstream migration. The hoop nets were located in Deep, South Fork Trout, Ball, Mission, and Boundary creeks. Thirty-six fish of eight species were captured, with one burbot captured in 2.8 m of water in Boundary Creek on February 9, 2004 (Table 5). The burbot was 515 mm in length and weighed 930 g (Appendix 4). The burbot was PIT tagged and released back into Boundary Creek.

RADIO TELEMETRY

No burbot were radio tagged in this study; therefore, no telemetry was conducted. The only burbot captured in Boundary Creek had an infected eye, and we were concerned that additional stress would further compromise the health of the fish.

Table 5. Catch data from tributary hoop netting from November 2003 through March 2004.

Tributary	Hoop net location	Set dates		Species captured	Total number
		From	To		
Deep	mouth	11/28/03	3/4/04	Northern pikeminnow	1
				Yellow perch	6
				Black bullhead	3
				Pumpkinseed *Lepomis gibbosus*	1
				Longnose sucker	1
South Fork Trout	mouth	11/20/03	3/1/04	Northern pikeminnow	1
				Pumpkinseed	4
Ball	mouth	11/28/03	3/7/04	Pumpkinseed	1
Mission	mouth	1/6/04	3/17/04	Northern pikeminnow	1
				Mountain whitefish	1
				Yellow perch	2
				Peamouth chub	1
				Pumpkinseed	1
Boundary	upper	2/17/04	3/11/04	Northern pikeminnow	1
				Black bullhead	1
Boundary	middle	12/3/03	3/18/04	Burbot	1
				Northern pikeminnow	3
				Black bullhead	2
Boundary	mouth	2/19/04	3/18/04	Northern pikeminnow	3
				Black bullhead	1
				Total	**36**

Stream Surveys

Stream surveys were conducted on six tributaries. In all, twenty surveys were conducted: two exclusively by boat, 3 exclusively by foot, and one using both methods. Most surveys were conducted during daylight hours but nighttime surveys were conducted at least once in three streams. (Table 5). No burbot were seen during any of the surveys. Other fish species seen during the surveys included mountain whitefish, slimy sculpin, northern pikeminnow, and longnose sucker. No fish were seen in Parker or Smith creeks.

Table 6. Visual burbot surveys conducted on west side tributaries to the Kootenai River during the 2003-2004 field seasons. Species codes are NPM—Northern pikeminnow, LNS—Longnose sucker, and MWF—Mountain whitefish.

Date	Tributary	Day/Night	Method	Number fish sightings	Species	Section surveyed
1/20/04	Deep	Day	Boat	0	N/A	Halfway point b/w weir and mouth down to confluence
2/4/04	Deep	Night	Boat	10	MWF	Weir site to mouth
	Deep			4	LNS	
2/10/04	Deep	Day	Boat	10	MWF	Weir to Mouth
2/18/04	Deep	Night	Boat	10	MWF	
				5	LNS	
1/25/04	SF Trout	Day	Foot	0	N/A	Weir to mouth
2/2/04	SF Trout	Day	Foot	0	N/A	Weir to mouth
2/4/04	SF Trout	Day	Foot	0	N/A	Weir to mouth
2/13/04	SF Trout	Day	Foot	0	N/A	Mouth to weir
2/20/04	SF Trout	Day	Foot	0	N/A	Mouth to weir
1/21/04	Long Canyon	Day	Foot	1	Slimy sculpin	Weir to mouth
2/2/04	Long Canyon	Day	Foot	0	N/A	Weir to mouth
2/20/04	Long Canyon	Day	Foot	0	N/A	Weir to mouth
2/11/04	Boundary	Night	Boat	45	MWF	
2/25/04	Boundary	Night	Boat	65	Slimy sculpin	
				50	MWF	
				50	NPM	
				3	LNS	
2/4/04	Myrtle	Day	Foot	0	N/A	Refuge tour start to east/west turn
2/8/04	Myrtle	Day	Foot	0	N/A	Refuge tour start to east/west turn
2/18/04	Myrtle	Night	Foot	1	N/A	Refuge tour start to east/west turn
2/5/04	Ball	Day	Foot	0	N/A	Mouth upstream 400 m
2/17/04	Ball	Day	Foot	0	N/A	Mouth to upstream 400 m
2/24/04	Ball	Day	Boat	0	N/A	Mouth to upstream 400 m

DISCUSSION

The capture of a single burbot in Boundary Creek (rkm 170) during February of 2004 coincided with the time of capture of two burbot in this tributary in 1999 (Paragamian and Whitman 2000). It is not known where the burbot captured in our study had traveled from, but one of the fish captured in 1999 was a recapture first tagged at about rkm 146. Boundary Creek was well known as an important spawning tributary with the capture of 199 burbot in a short span of time during the winter of 1957-1958 (Partridge 1983). The failure of capturing more burbot in Boundary Creek or in the other westside tributaries does not definitively demonstrate that there are no burbot using these tributaries in the winter for spawning. However, it does underscore the imperiled population status of the burbot in Idaho. The fact that a dead female burbot was retrieved from the north bank of Deep Creek approximately 3 km downstream of the weir indicates there was at least one burbot near Deep Creek during the winter of 2003-2004. In addition, as previously mentioned a dead burbot was also found near Deep Creek in winter of 2002-2003. Whether or not either burbot came from the creek or the mainstem Kootenai River is unknown, but these collections do suggest a remnant-spawning run may be using Boundary and Deep Creek during years of adequate migration conditions (Paragamian 2000).

Some sampling bias with weir traps may have played a role in the failure to capture burbot in Deep Creek and other tributaries with similar substrate. Due to the shifting sand bottom of Deep Creek, small holes were created frequently under the picket fencing. The weir was checked daily for holes and these were tended to, but there is the possibility that small burbot were swimming through the 25 mm wide picket weir. Burbot have a long narrow torso and can easily slip though net gear as well as weir material, with other studies finding that burbot could dig underneath weir material and get through undetected (Arndt and Hutchinson 2000). The weirs on Long Canyon and South Fork Trout creeks had gravel/cobble bottoms, and it would be unlikely burbot could have dug under these weirs.

In an ideal situation, the weirs could have been placed in the tributaries at the confluence with the mainstem Kootenai River. Sampling at the confluence would have ensured a greater likelihood of capturing any burbot entering the tributary, because there would have been a greater chance for capture and detecting their presence. However, mainstem water levels fluctuated too much to effectively run a weir, and they had to be placed upstream to moderate the backwater effect from the mainstem river. In this case, there is a chance to miss burbot entering the tributaries. We tried to mitigate this by conducting visual stream surveys, but sometimes the tributaries were snow and ice covered, making visual sightings impossible.

There are other tributaries in the Kootenai River drainage in Idaho that could provide suitable spawning habitat for burbot. Logistical and monetary restraints prevented investigating these other tributaries. As stated earlier, Deep Creek was chosen because a dead burbot was found along the banks in February 2003. South Fork Trout and Long Canyon creeks were chosen because of their potential good spawning habitat and to collect winter fish trend data to supplement restoration efforts of the KTOI, Free-Run Aquatic Research, and the Bonneville Environmental Foundation currently underway. Passive restoration efforts, including new grazing management plans, planting native tree and shrub species, and fencing were started in 2000 and continue. An aquatic biomonitoring sampling plan, in which water quality, water temperature, algal, benthic macroinvertebrate, and plankton data is gathered, occurs concurrently with restoration efforts.

In general, temperatures of upper sites of tributaries are consistent with respect to average November to March temperatures, with the notable exception of Deep Creek; they all have very similar temporal profiles. However, the lower sites can be more variable and warmer both with respect to average November to March temperatures and to the shape of the annual profiles. In addition, where we have data for both upper and lower sites, two streams (Ball and South Fork Trout creeks) will show a marked declining gradient of average November to March temperatures from lower (>2.5) to upper (~1.0) and two show low average November to March temperatures (~ 1.0) at both sites (Parker and Long Canyon creeks). It seems obvious that the upper watersheds share a common climate and experience no mixing with mainstem Kootenai River water so they are similar. On the other hand, the difference in temporal profiles may be because some streams are in a more open valley in comparison to the canyon walls of the other tributaries, thus opening creeks to more thermal radiation in winter. It has already been shown that discharge likely impedes passage mechanically for the low endurance swimming burbot (Paragamian 2000). Studies of temperature and burbot movement are now underway to project how the temperature profiles of pre- and post-Libby Dam may also have effected burbot migration and if increased main river flows also exacerbated the postulated homing problem associated with mixing and thermal gradient dilution at tributary mouths.

Although we documented temperature data for seven of the eight tributaries, it was of no immediate value because we failed to capture burbot in these streams. Temperatures of these

tributaries were all within the published range for burbot spawning temperatures, including the Goat River, British Columbia (McPhail and Paragamian 2000). Temperature of Boundary Creek was about 1°C on February 9, 2004 (Paragamian, in progress), the day of the single burbot capture of this investigation. The temperature and day closely coincided with the spawning temperature and period of burbot in the Goat River (Paragamian 2000).

The tributaries to the lower west side of the Kootenai River are important for native fish populations for many reasons. The obvious reason includes providing critical spawning habitat for burbot but also providing spawning and rearing habitat for prey species, such as mountain whitefish and peamouth chub, that burbot and other native fish populations depend upon. From this study, we found that there was a small run of peamouth chub in December in Long Canyon Creek and a run of mountain whitefish in Deep Creek.

Burbot tributary winter use assessments are important for recovering the Kootenai River burbot population. Identifying critical spawning habitat and implementing preservation and/or restoration efforts is one important step toward a more functional Kootenai River ecosystem.

RECOMMENDATIONS

Although this effort to capture burbot spawners with weir traps was unsuccessful, it is believed to have been worth the single attempt. We do not advise a similar follow up study at this time because it is evident burbot are scarce and either no captures or very few captures could be expected. However, limited hoop net sampling is not as time consuming and is recommended but is already a task within a companion study. Weir traps may be employed in the future if rehabilitation efforts are successful in rebuilding population numbers of burbot or there is experimentation to establish tributary spawners with donor stocks.

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APPENDICES

Appendix 1. Close-up of the upstream and downstream weir traps (a) and photograph of the Deep Creek weir (b) after installation in December 2003. Note the sand creek bottom.


a.


b.

Appendix 2. Close-up of the upstream and downstream weir traps (a) and the Deep Creek weir (b) after ≤20°C temperatures in mid January 2004. The weir withstood the thick icepack upstream of the pickets and boxes.

a.

b.

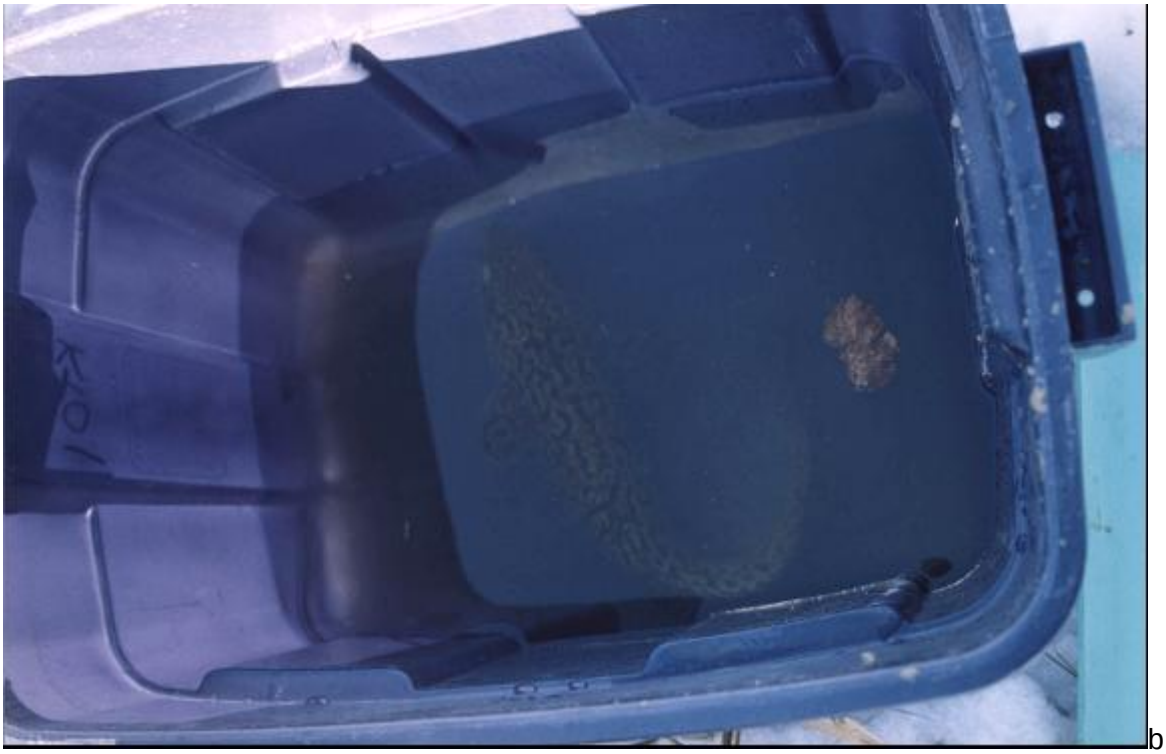
Appendix 3. Close-up of the upstream and downstream weir traps (a) and photograph of the South Fork Trout Creek weir (b) after installation in November 2003.

a.

b.

Appendix 4. Photographs of the location of the hoop net (a) and the burbot (b) captured in Boundary Creek, Idaho on February 9, 2004.

a.



b.

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